Low Band Receiver Noise Reduction or Elimination

Purpose:
The thrust of this article is to reduce the noise levels primarily for EmComm operation on the low bands (160m, 80m, 60m, and 40m; but more specifically the most widely used HF EmComm Band, 80 meters. It is designed as an introduction and reference for more elaborate details found in a plethora of books and the internet. Simple and easy common corrections for RF noise problems are also found in the following pages.

HF Band Characteristics
Noise levels on 160m, 80m and 60m are most often the highest when compared with 40m and shorter wave lengths. Noise levels above Signal Strength S 3-4, will drown out weak signals (those S4 and below), thus obfuscating communications. In the modern urban environment, many stations experience noise levels S9 plus, thus hampering communications with weaker stations. There are many causes and thus many remedies that are worth investigating.

Our modern urban environment produces many sources such as generators, high voltage power lines, solar photo voltaic inverters, faulty power line transformers/insulators, outdoor hi-pressure sodium lights (HPS), other HID lighting, wall warts, switching power supplies, and numerous other possibilities, most of which can be methodically identified and remedied. We will explore common situations and their solutions below.

Investigations should note what frequencies are involved, time of day, and other notable characteristics (such as pulsing, staccato, constant, intermittent, etc.).

For example, are there outdoor HID lights that go on at night? We will provide links to how to identify and remedy.

Is your antenna close or parallel with high voltage power lines/or service drop? Dipoles and long wires are best run perpendicular if possible. Underground service is of course quieter than overhead services. Indoor electronic devices such as plasma TVs, switching power supplies, wall warts, LED light bulbs, radio-controlled devices, drones, portable phones, surveillance devices, power line controllers (PLCs), etc., can often be troublesome sources. Most if not all the above sources can be tracked down, some being easier than others. Please consult the many resources below as to the many effective identification and elimination processes. **IT IS ABOVE ALL ELSE NOT A LOST CAUSE.**

Reduction and elimination of receiver noise is a very large topic in radio communications. Identifying the source and eliminating it at the source is best. Identifying the cause and ameliorating it is a second option, while simply ameliorating it without knowing its source or cause is the third best course of action.

Common Natural Causes are:

Rays from outer space.
Solar storms and magnetic disturbances
Lightning and atmospherics
Precipitation statics

The Rest are Manmade noise sources from inside the house or outside.

Some noises are even generated **inside the receiver** itself such as birdies or internal noise that impairs the dynamic range characteristics and hence the signal to noise ratio (SNR). Electronic circuits themselves can generate unwanted noise. Signal to noise levels depend upon receiver design. Poor receiver filtering design and overly wide or unprotected front ends, such as poor implementation of Digital Signal Processing (DSP), Pass Band Filtering, Digital Noise reduction, Noise Blankers, Roofing Filtering, etc. if designed well, can significantly reduce noise.

Noise from outside the receiver both in house and outside can be numerous such as due to switching power supplies, other electronic devices, AC power transmission lines, generators, inverters, old CRT monitors, LED light bulbs, TVs, dimmer switches, Switching power supplies, refrigerators, etc.

Some causes arise from i**nside the house**, o**utside the house,** or from i**nside the receiver**. Common sources can be a neighbor's device, light poles, intermod, lack of filtering, near station desensing, harmonics, HID lightning, neon sign transformers, poorly designed inverters, nearby power stations, dimmer switches, fluorescent light ballasts, high tension electricity towers, auto ignition noises, electric cars, or their combination thus creating a modern urban noisy ambiance.

Since most outside radiated noise are vertically polarized vertical antennas are noisier than others,

Troubleshooting sources inside the house:
It is easy to trouble shoot the source of inside generated noise. Turn off the main circuit breaker and power supply, running the receiver on battery power. If the noise level is reduced, then track down the individual inside circuit and device by unplugging them one by one. Dimmer switches can be turned on/off, as can various lighting sources, and devices methodically. There exist remedies for most sources, but first identification is necessary. You're done. You have identified and eliminated noise emanating from inside the house, congratulations.

Troubleshooting Outside Sources:
a) Antennas
Outside sources can be more difficult to isolate, identify, and remedy. Often the problem can be traced to the antenna. Broad band or multiband antennas especially can pick up more frequencies than a resonant antenna. Some antennas pick up more stray noise than others.

Discones and wide-band specially antennas such as ALE (Automatic Link Establishment) antennas accentuate unwanted ambient noise. They are used for all-band and spread-spectrum like security oriented EmComm systems and other encoded automatic frequency and band hopping radio comms designed for security purposes, are suitably designed for broad-band and all-band use. However, as such, they can increase the pickup of stray RF across the radio spectrum, thus being labelled noisy.

Vertical antennas pick up more ambient noise, which is more often vertically polarized. Coax and unbalanced feeds can be more prone to noise than window or ladder line. Eliminate common mode noise (see below).

Magnetic loop antennas are generally considered to be the quietest receive antennas, but I do not have any direct experience with their transmission. Quads and Delta loops are quieter than dipoles. Dipoles are quieter than verticals. Antennas located lower to the ground are quieter than those higher up. RF Chokes can be used to eliminate RF on the shield and reduce unwanted radiation and noise (common mode noise).

In general, balanced antennas such as dipoles and balanced feedlines such as ladder/window line are less prone to common mode noise. Even poorly matched baluns at the antenna feedpoint may generate noise on coaxial transmission lines.

b) Methodology

Identifying noise sources outside the shack can often be identified using a directional antenna (dishes, yagis, quads, log periodics, etc). Using a battery powered portable AM radio can be helpful in tracking down AC noise sources. Gauss and EMF meters also exist that can measure electromagnetic fields. Some radio clubs have RFI/TVI committees or radio direction finding (RDF) work groups where they hunt down noise sources and also help members who were interfering with neighbors' or their own electronics (TVs, radios, telephones, stereos, etc.).

The above data comes from experience and can be confirmed by scientific theories, but there are always "anomalies".

Conducted versus Radiated Noise

Often, noise is categorized as either conducted or radiated. However, one can turn into the other. This is how.

Conducted noise such as line noise and electric motor noise depends upon a conductive medium of transmission, such as a conductive wire. This method requires a physical conduction route that transfers electromagnetic emissions to connected equipment. Common paths for conducted emissions include power cables and electrical interconnection cabling. Conducted noise can also radiate, and radiated EMI can be picked up by wires and be conducted.

PLCs (Power Line Controllers) are used for industrial control, and in commercial applications for applications like control of HVAC systems. They're finding increased use in homes, apartment buildings, and condos as well. The X-10 control system is a basic PLC system that has been around for many years. PLCs use existing powerlines to send control signals to an embedded device in the house, sort of a precursor to Broadband Over Powerline (BPL) that threatens reception on the HF bands. This what a PLC EMI sounds like http://www.arrl.org/files/file/RFI%20Sounds/plc-4.mp3 Thanks to the ARRL Labs for the sound.

Conducted noise can be as annoying as simple ground loops, to a complete system breakdown such as a large power surge. Ferrite beads are often used to filter out conducted noise on cables. Capacitors to ground can also filter out conducted RFI on DC circuits, shorting them to ground.

Line Noise (conducted)

Isolating all your electronic equipment including the radio gear, power supplies, computer inverters, and the like can be accomplished by 60 Hz 120/240 VAC line noise filters. As a remedy there exist whole house line filters installed off the main circuit panel (expensive) and task type line filters where you can plug in multiple outlet strips.

The AC line can act as a two-way street by conducting RFI from outside as well as conducting RF from the shack out to the power lines and into your neighbor's house under specific circumstances.

More difficult to eliminate are bad neutral grounds at the pole or at the neighbor's main service panel where return currents are searching for ground next door (rare). The latter solution is best left to an electrician to trouble shoot.

Radiated EMI (electromagnetic interference) requires no physical contact. These emissions happen when devices produce intentional or unintentional electromagnetic energy in the form of an electrical field. Damage from EMI-radiated emissions occurs through induction. Radiated emissions spread outward, sometimes traveling long distances. Depending on their proximity and severity, they can have unwanted impacts on receiving devices located within the vicinity. These electrical emissions can also interfere with the source device operation if they overwhelm the circuitry, hence noise reduction measures often need to be implemented.

Electronic circuits in PCBs (Printed Circuit Boards) contain time-varying signals that propagate into space as undesired stray electromagnetic radiation. Similarly, every conductor is an antenna that is capable of both transmitting and receiving signals. The implementation of modern RF communication devices, wireless transmission and reception may also generate and receive noise. This noise in the context of its effect on a separate circuit or

device, it becomes “radiated EMI.

“Circuits both generate and receive radiated EMI, and the operational environment of the device determines which of these realities presents a greater challenge to the engineer. If you’re designing a high-precision sensor board that must be in close proximity to a brushed DC motor or a wireless power transmitter, coping with received EMI will be the priority. If you’re developing an embedded device that has to meet FCC emissions requirements, you’ll probably need to focus on generating less EMI.”

~ https://www.allaboutcircuits.com/technical-articles/difference-between-conducted-EMI-radiated-EMI-electromagnetic-interference/

Of course, blue tooth, cell phones, portable mobile telephones, radio control devices, drone controls, even automobile alarm and entry devices, garage door openers, home surveillance devices, etc., all are designed to radiate signals, many which are not very clean. Turning them off or removing their batteries temporarily may solve problems when all else fails.

Further Studies

Identifying the causes by analyzing the sound and wave forms
Here you can find recorded sounds of RFI. In today's urban environment there can be many discrete contributing vectors which combine as a "hash" -- the modern-day urban ambiance.

This is a good source to identify sources by sounds.
http://www.arrl.com/sounds-of-rfi or the same page but different URL http://www.arrl.org/sounds-of-rfi

An oldie but goodie https://www.on4ww.be/emi-rfi.html

A general article on RFI http://www.arrl.org/radio-frequency-interference-rfi

An excellent compendium of Source Material
http://radiojove.org/SUG/RFI/RFI.html

Noise by Season, Frequency, and Solar Activity:

Solar flares, CMEs, Sunspots, solar winds/storms, and other off planet events can generate noise and wipe out communication for periods of time. NOAA. NASA, NBS, and other organizations predict space weather daily.

In general, lower frequencies have higher noise levels and as we move up in frequency the noise floor drops. If short skip/hops of 300 miles or less are desired, then we need to pick a usable frequency according to the season, the sunspot cycle, and time of day. 40m is generally good for medium to short skip during the day (California, Oregon, Arizona,

Nevada, Utah, Washington State, Idaho), but soon gets long after dusk (good to Hawaii, AK, and later at night to Japan, Australasia, and Asia. Early morning around dawn Europe on 40m, 30m, an 20m is not uncommon. Even 80m will give us Asia late at night and into the early morning.

80m gets longer in the winter (shorter in the summer). In the height of the Sunspot cycle 40m is good for short skip in the summer during the daytime. In the summer during the height of the SS cycle, 60m and 80m will remain shorter and more reliable for longer periods into the night (better for Contra Costa County short skip, but less DX). Very short skip from Co Co West County into Martinez (11 miles) or Walnut Creek (14 miles) over the East Bay hills is very difficult without NVIS propagation, while at the same time propagation to Sacramento, Redding, and San Diego may be excellent.

In the summer during the height of the SS cycle 20m opens up all night for DX, but usually 20m is impossible for Northern Cal to Northern Cal contacts day or night due to wavelength characteristics that interface with the ionosphere. It's also not generally good even for Southern Cal to Northern Cal, but such is possible depending. 20 meters is excellent for intermediate and long skip (DX) (500 miles and greater).

Modes

The above should hold true for CW. SSB, VARA, Packet, and other digital HF modes except for WSPR and FT8 which are excellent in the sense of being able to operate below the general noise floor, but inadequate for message handling.

Common mode noise – chokes, ununs, guanellas, and isolators

“In the shack and during reception, common mode coax sheath currents contribute to the reception noise floor, hence reducing the signal-to-noise level of desired signals.” One method to reduce or eliminate common mode noise is the judicious use of ferrites. Ferrites made of #31 ferrite mix are the best for HF common Mode reduction. Ferrite #31 cores cover 1 MHz to 300 Mhz and can prevent, reduce or eliminate the RFI carried by the coax cable. The ferrites can be installed either at the antenna feed point or right behind the antenna tuner.

Specially designed chokes and baluns also are effective. Chokes not only reduce your transmit RFI potential but will lower your noise floor so that you will hear better.

Balanced antennas and feedlines

From K9YC: “In an ideal radio system, the transmission line for our antenna would act as if the transmitter (or receiver) was physically located at the feedpoint of the antenna, with nothing in between. There would be no loss, and no interaction of the feedline with the antenna. We've gotten to this point with microwave systems – indeed, all of the RF electronics for many of these systems can clamp onto the back of a dish and drive it directly.

We're not there with HF (or even VHF) systems though, and not likely to get there, thanks to the power levels, wavelengths, and antenna types that are practical. So in the real world, we're stuck with transmission lines for most of our antennas. The primary function of most baluns, at least in our ham stations, is to minimize the interaction of our antennas with the transmission lines that connect them to our radios. So let's dive in and learn a bit more about how antennas, transmission lines, and baluns work.

Balance

Let’s begin by defining circuit balance. A balanced system is not defined by the equality of current or voltage on the two conductors. Rather, a balanced circuit is one in which the impedances of the two conductors to the reference plane are equal in both magnitude and phase. A balanced circuit functions as a Wheatstone bridge, rejecting noise by virtue of the balance of the impedances within that system. [There is an excellent analysis of this by Whitlock, in the Journal of the Audio Engineering Society (JAES, June 1995), available in most university engineering libraries, and AES.org

Antennas and Balance We like to think of a center-fed dipole as a balanced antenna, and in an ideal world it would be. To achieve that, we would need to suspend it over perfectly flat and uniformly conducting earth, between electrically symmetrical support structures. There could be no buildings below it, no wiring, no conductive objects around it that were not perfectly symmetrical with the antenna, and the feedline would need to be perfectly perpendicular to the antenna all the way to the transmitter.

As hams, few of us are able to install anything approaching a balanced antenna, especially for the lower HF bands. We must suspend them from metal towers, trees, or the side of building. Often the ground beneath them is not flat, soil conductivity is non-uniform, there are power lines, telephone lines, and there is wiring in nearby buildings. The antenna has capacitive and inductive coupling to all conductive objects in its near field. Rarely will that coupling be symmetrical, and rarely will it be possible to quantify it. In short, even the best of our antennas are a compromise

An example of a ham antenna that might have met that criteria of a balanced antenna was a dipole I was able to hang between two identical towers on top of the EE building at the University of Cincinnati when I was a student and trustee of W8YX in the early 60's. I used the word "might" because although the towers were mounted symmetrically on the building, one held a large beam. There goes the balance!

Even with ideal ladder line feeding our real world "sort of" balanced antenna, the antenna imbalances cause the currents in the two halves of the antenna to be unbalanced (that is, unequal), so the current on two sides of our balanced feedline are not equal. The imbalance between the two currents is a common mode current, and it causes radiation from the feedline! And because all antennas work in reverse, any current flowing on the feedline couples unequally to the two sides of the antenna. The difference between those currents is sent back down the feedline as a differential signal to our receiver. That feedline current could be noise from our neighbor's battery charger, or a station coming from a direction we thought our beam antenna was rejecting.”

Quoted from, “A Ham's Guide to RFI, Ferrites, Baluns, and Audio Interfacing”, Revision 7 Jan 2019. by Jim Brown K9YC See his extensive article collection here: http://k9yc.com/publish.htm

The following are technical articles on antenna and feedline designs that reduce common mode noise and AC power line noise.

https://www.balundesigns.com/all-ununs/

https://www.balundesigns.com/1-1-baluns/ chokes

https://www.balundesigns.com/feedline-isolation-baluns/ ***

Articles https://www.balundesigns.com/reference/

Ladder/Window line https://www.balundesigns.com/reference/antenna-matching-problems-using-ladder-line-or-open-wire-feedlines/

Two examples of avoiding high voltage (high impedance) points:

1. You have a dipole and you want to make it into a multibander using a tuner.
You calculate that it is about 135 feet long for 80 meters...
You would use either, 34-40, 90-102 or 160-172 feet for the feedline going to your tuner or balun such as models 1171, 4114, 4115, or 4116.

2. Your dipole is cut for 40 meters or about 66 feet total length and you feed it with 450 ohm window line to a tuner to make it a multibander.
You would use either, 42-52, 73-83, 112-123 or 145-155 feet according to the chart above.

https://www.balundesigns.com/blog/baluns-for-multiband-antennas-fed-with-open-wire-or-ladder-line/

https://www.balundesigns.com/reference/swr-and-the-impact-of-your-feedline-/

https://www.balundesigns.com/reference/noise-sources-rfi-and-their-suppression/

“With the advent of new technology in TV's, power supplies/chargers, new lighting products and other modern devices, there is an unfortunate downside from the electronic noise many of these items generate. To that end, we receive numerous emails and calls seeking a remedy to the ever-increasing noise floor in our receivers.
No question that baluns are one of the answers, but they are not the sole answer and in some cases are not the answer at all. To better understand this statement, it is important to understand the different sources of noise and how they can be dealt with.

First is noise generated by common mode currents which can be induced on the shield of a coax feedline if it is exposed to strong RF such as those from a nearby high-power AM station. The shield is also subject to common mode if it runs close to or through electrical fields created by AC lines in your home or electrical equipment (like switching power supplies) located in close proximity to the feedline. Common mode that distorts your audio creates "mic bite" occurs when the coax feedline passes through the radiated RF near field from your antenna. Common mode currents can also be created by a large impedance mismatch at the feedpoint of an antenna. It should be noted this is only an issue when coax is being used and not with open wire or ladder line feedlines.

The good news is that high quality 1:1 baluns (aka feedline, isolation and or choke baluns) can usually eliminate this type of noise or RFI when installed in the feedline close to your equipment. Note the term "*high quality*" which means if you think the price is a good deal, the chances are the balun is not! Additionally, having one installed at or near the feedpoint of your antenna is not only beneficial to your transmitted signal, but can also be a first line of defense in the war against noise. This type of balun should generate high levels of choking impedance on the bands where the noise is the is most noticeable while having negligible insertion loss to any incoming signal.
Be aware that baluns claiming extreme levels of choking impedance typically use cores that are not well suited for use on HF frequencies and also have a fairly high insertion loss. These baluns should be considered as suspect and avoided especially if from unknown sources.

It should be noted the air wound coaxial chokes sometimes called "ugly baluns", have very limited effectiveness and tend to have a very narrow peak of choking impedance. Also, baluns wound on low permeability cores such as iron powder types are basically worthless. Conversely baluns wound with high permeability cores to artificially increase the measured choking impedance also have very high insertion losses.

The second type of noise comes from a differential source and is exactly the same as a received signal whether it be SSB, CW, RTTY, AM or any of the other modes. These sources can be atmospheric in origin or worse from the dreaded faulty power line on above ground transmission poles. This type of noise cannot be suppressed by a balun and can usually only be minimized using DSP (digital signal processing) whether in your transceiver or external processing like the excellent line of *Hear It* products from BHI.
RFI whether in your stereo, telephone, smoke detectors or your neighbor's electronics require a different approach using ferrite toroids or clamp on ferrites. Mix 31 or as some call it 31 material, is excellent when used to suppress this type of RFI and is highly recommended. QST has published a very good short article that will help you understand how radiated RF enters your electronics and how they should be suppressed. It can be accessed using this link. "
from http://www.balundesigns.com/content/RFI.pdf QST Article on Noise

https://www.balundesigns.com/reference/core-material-selecton-for-baluns-and-ununs/

http://www.w8ji.com/noise.htm Noise

Windom (OCF) http://www.w8ji.com/windom_off_center_fed.htm

Common Mode in the Shack http://www.w8ji.com/verticals_and_baluns.htm

Feedline Common Mode Noise http://www.w8ji.com/common-mode_noise.htm

Choosing Choke Baluns http://www.w8ji.com/core_selection.htm

http://www.w8ji.com/power_line_noise.htm Power Line Noise

https://www.w8ji.com/radiated_and_conducted_noise.htm

https://hamwaves.com/chokes/en/index.html Common mode chokes and guanella

"In the shack and during reception, common mode coax sheath currents **contribute to the reception noise floor,** hence reducing the signal-to-noise level of desired signals."

Short Dipoles http://www.w8ji.com/short_dipoles_and_problems.htm
Precipitation Static http://www.w8ji.com/pecipitation_static.htm

A Ham's Guide to RFI, Ferrites, Baluns, and Audio Interfacing, by Jim Brown K9YC. Very thorough!
http://k9yc.com http://www.audiosystemsgroup.com/RFI-Ham.pdf

Slide show by k9yc on the 2021 Pacificon Antenna Forum about my 2018 HF Choke Cookbook. October 2021

This is a Cookbook for VHF-UHF Transmitting Chokes. July 2020

RFI, Ferrites, and Common Mode Chokes For Hams Most recent update January 2019. This tutorial is directed specifically to RFI in ham radio applications. It includes an extended discussion of the use of common mode chokes as transmitting baluns, and extensive measured data on ferrite chokes. A chapter on audio and computer interconnections in ham stations shows how to make bulletproof connections between a computer sound card and ham rigs for SSB, RTTY, PSK31, and SO2R contesting without expensive interface boxes, using nothing more than simple cables with the right connectors on each end.

This is a brand new Revised Choke Cookbook, by K9YC for Transmitting Chokes For 160-10M. http://k9yc.com/2018Cookbook.pdf December 2018

K9YC slides for talk at Visalia about the many forms of interference in Multi-Transmitter Stations and how to minimize them. May 2019

K9YC wrote for National Contest Journal called Build Contesting Scores By Killing Receive Noise.   Here are the slides   for the 2017 talk at the 2017 Visalia DX Convention. May 2017

Survey of Bandpass Filters for Contesting by K9YC. This pdf of that report includes a link to a page with additional pdf files of the raw data for each filter and each band. September 2014

Bandpass Filters using W3NQN designs

KF7P YouTube video – all about ferrites

https://kf7p.com/KF7P Chokes,, baluns, ferrites, etc.

An excellent cheap common mode choke in 3 parts (pt1, pt2, ad pt3) follows:
https://kf7p.com/KF7P/Tech_Resources_files/NCJ%20Jan-Feb%202013%20p1of3.jpg
https://kf7p.com/KF7P/Tech_Resources_files/Ecellent%20Choke%20%20p2of3.jpg
https://kf7p.com/KF7P/Tech_Resources_files/Excellent%20Choke%20p3of3.jpg

Common-mode Chokes by G3TXQ https://www.pc5e.nl/downloads/antennes/RF%20Choke.pdf

Clean Up Your Shack—RSGB 2015 Presentation by Ian White, GM3SEK (YouTube Video https://www.youtube.com/watch?v=LSL1h6MJbaI)

https://palomar-engineers.com/antenna-products/1-1-balun-kits/super-choker/

https://palomar-engineers.com/balun-and-unun-styles

https://palomar-engineers.com/ferrite-application-experts-2/Coax-Noise-Filters-c24774281

https://palomar-engineers.com/ferrite-application-experts-2/AC-Power-Filters-c24774278

https://palomar-engineers.com/rfi-kits/ham-radio-rfi-solutions/transmitter-rfi-kits/

https://thewireman.com/product/ferrite-clamp-rg8-2x31-4181p2/

https://thewireman.com/product/ferrite-clamp-rg8x-rg58-coax-type/

https://thewireman.com/product/toroid-t200-2-iron/

https://www.pa9x.com/the-broadband-common-mode-choke/

The RF Noise Identification Website of VE3HLS

From the ARRL RFI Page don’t forget these excellent articles if you are still plagued by RF Noise:

External Links from the ARRL http:/www.arrl.org/tis/info/HTML/rfi-noise/links.html

What Is It? While this question may seem intuitive, it may be the wrong one to ask if you have an RFI problem. By Ed Hare, W1RFI.

Electronic Noise Is Drowning Out the Internet of Things. Our increasingly connected world needs better protection against RF noise pollution, By Mark A. McHenry, Dennis Roberson & Robert J. Matheson. *IEEE Spectrum*, August 18, 2015

Hunting Down RF Noises. Find noise sources both outside and inside your home with a systematic approach, by Michael Foerster, W0IH. *QST* February 2015, p 45.
An Easy Primer Eliminating RFI from inside your shack by KI6NAZ https://www.youtube.com/watch?v=QQzmMOJvFfc

Locating RF Interference at HF. A proven and practical approach to dealing with RFI from grow lights and more, by Tom Thompson, W0IVJ. *QST* November 2014, p 33.

A Quick Look at Radio Frequency Interference, by Joel R. Hallas, W1ZR. *QST* May 2009, p 61.

Interference Primer - Parts 1 and 2 Derived from *QST* Lab Notes columns. Contains general information on Radio Frequency Interference.
RFI: ARRL Laboratory On Television--WATCH!

ARRL's Ed Hare, W1RFI and Mike Gruber, W1MG talk about RFI problems on a Common Point, a Cable Access TV show hosted by Dan Thomas. Mr. Thomas serves on the Board of Directors of the Vintage Radio and Communications Museum of Connecticut (VRCMCT). Associate Producer: ARRL Assistant Laboratory Manager, Bob Allison, WB1GCM.

Clean Up Your Signal With Band Pass Filters (ARRL) by By Ed Wetherhold, W3NQN

Identifying & Locating Power Line Noise, Produced by the ARRL Laboratory, written and directed by Bob Allison, WB1GCM and narrated by Jerry Ramie, KI6LGY

YouTube Video “Finding and Fixing RFI” by the ARRL https://www.youtube.com/watch?v=y0dmgeORiFQ

Power Line RFI Investigation in Pleasant Hill, California, Video of an RFI Investigation in Pleasant Hill, California.

Intermod fixes http://www.arrl.com/intermodulation

Smart Meters http://www.arrl.com/smart-meters

Noise from your automobile http://www.arrl.com/automotive

Noise from Broadband over Power Lines (BPL) http://www.arrl.com/broadband-over-powerline-bpl

Hunting and fixing RFI in the shack
https://www.youtube.com/watch?v=H-PL_nUk2v0

A success story eliminating RFI from ether net cables using ferrites

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